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Upgrading Oregon State's Multidirectional Wave Basin for Remote Tsunami Research

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Project Goals

Develop experimental facility for tsunami research community

- **Leverage existing wave research facility**
- **Expand capacity to tsunami waves and 3-D bathymetry**

Enhance effectiveness of tsunami researchers

- **Reduce requirement for on-site presence**
- **Facilitate re-use of previous experimentation**
- **Support integration of simulation and experimentation**

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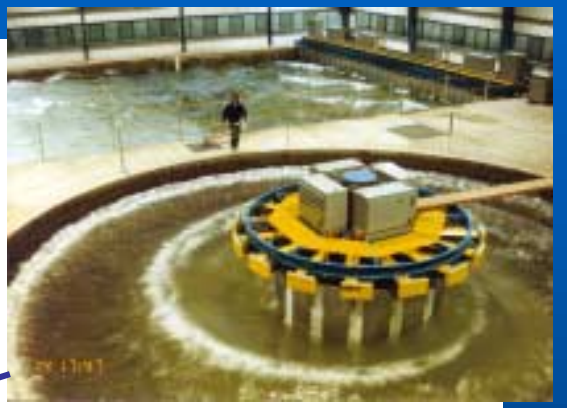
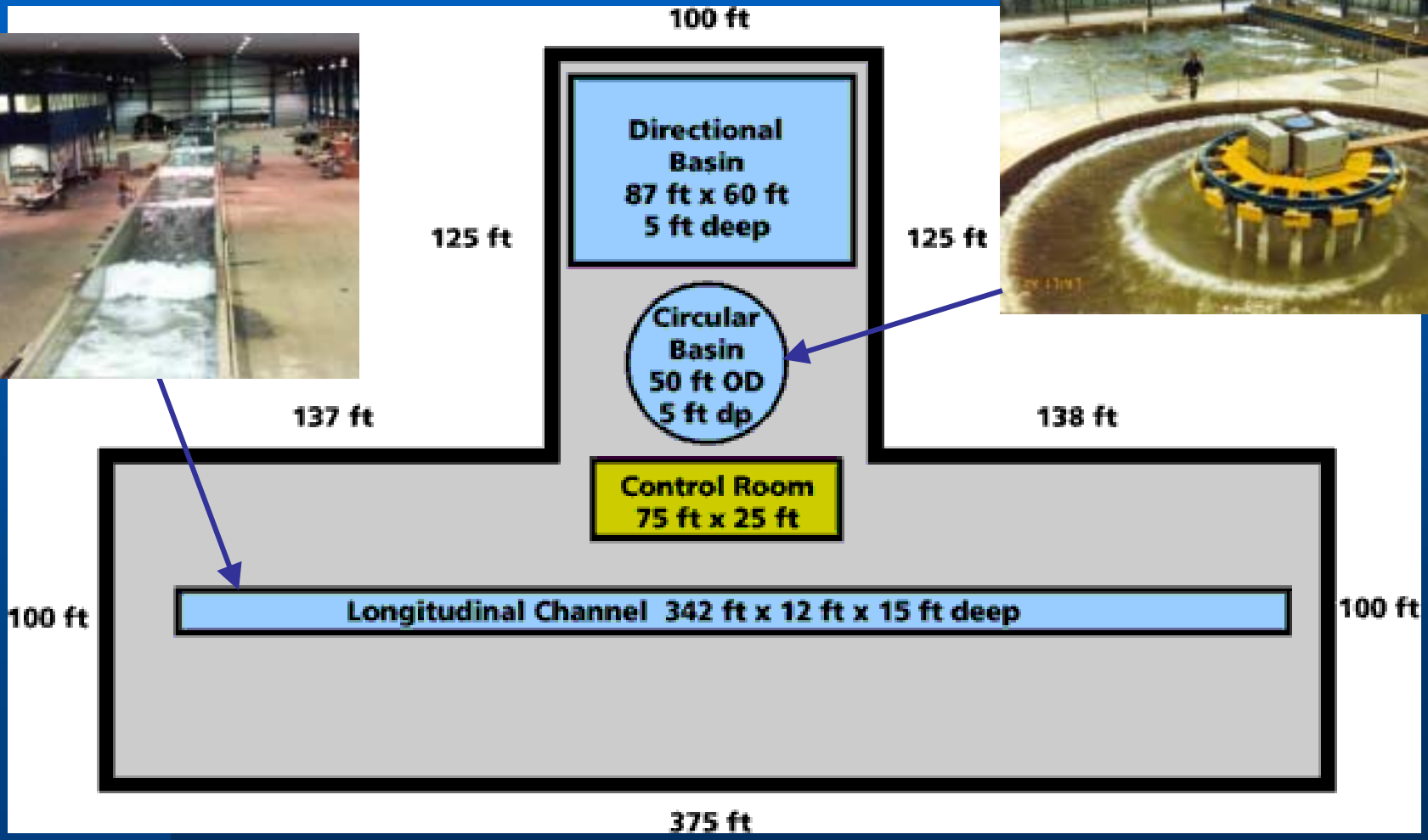
Wave Research Laboratory





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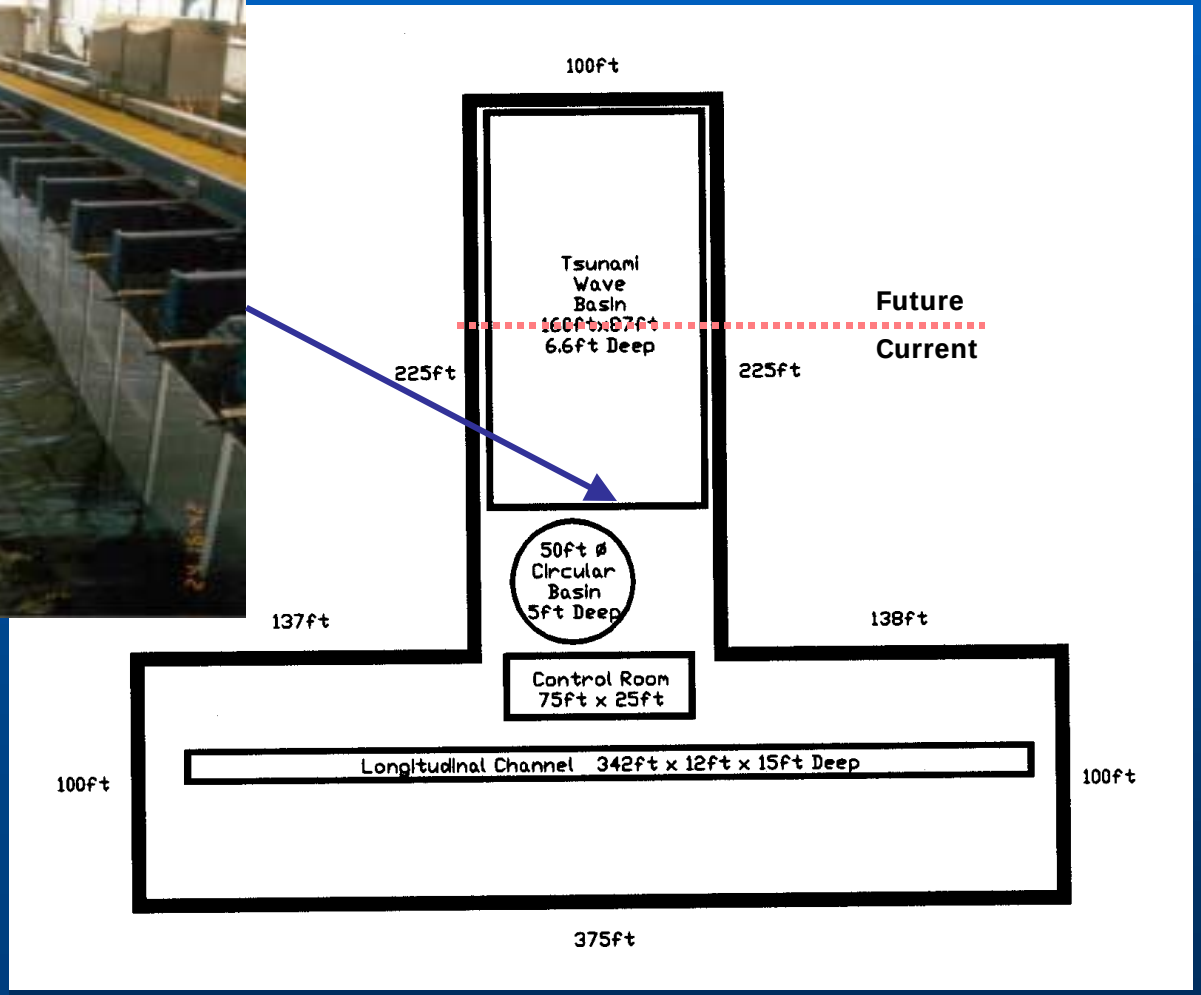
Tsunami Wave Basin Expansion



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Facility Dimensions and Generator Capacity

- **Existing Basin**
  - Length : 87 ft
  - Width : 60 ft
  - Depth : 5 ft
- **Updated Basin**
  - Length : 160 ft
  - Width : 87 ft
  - Depth : 6.6 ft
- **Existing Generator**
  - Stroke : 3 ft
  - Velocity : 1.6 ft/sec
  - Tsunami Height : 0.7 ft
- **Updated Generator**
  - Stroke : 6.6 ft
  - Velocity : 6 .1 ft/sec
  - Tsunami Height : 2.6 ft

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Instrumentation

- Electro-resistive wave gauges
- Doppler velocimeters
- Pressure gauges
- Accelerometers
- Force transducers
- Laser, radar
- Surface/underwater cameras
- Microphones
- Hydrophones

Sampling Rates

- 100 channels @ 100 Hz for 100 seconds (wave profiles, velocities)
- 20 channels @ 5 kHz for 10 seconds (impact pressures, forces, motion)
- 10 video channels @ 10M pixels @ 30 Hz for 100 seconds (6 surface and 4 underwater cameras)
- 4 audio channels @ 50 kHz for 100 seconds (microphones, hydrophones)

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Vision of Future Operation

- Host web-based forum on tsunami research world-wide, status of state-of-the-art numerical models (e.g., FE, FD, BE, MAC, Hybrid) and codes development
- Host database of existing tsunami experiments
- Collaborate/facilitate potential PIs planning and design of experiments
- Build lab models and conduct tests at Tsunami Basin
- Real-time interaction with PIs and research community during model tests
- Provide web-based forum for post-test calibration of various simulation models with experimental results including graphical comparison and animation

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Envisioned Tsunami Basin Experiments

- **Scale Effects in Tsunami Runup and Velocity Measurements**
  - **Reynolds Number : Viscosity**
  - **Finite Amplitude : Convective Accelerations**
- **Macro-Roughness Effects on Tsunami Behavior**
  - **Wave Attenuation : Natural and Constructed Roughness**
  - **Debris Flow : Motion Initiation and Debris Concentration**
- **Tsunami Wave Forces on Structures**
  - **Small Structure Force Coefficients : Lift, Drag, Inertia**
  - **Large Structure Diffraction**

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Envisioned EQE Collaborative Experiments

- ***Example :*** **Oil storage tank research**
  - **Foundation liquefaction and damage using NEES centrifuge**
  - **Tank damage from earthquake using NEES shake table**
  - **Tsunami impact forces using NEES tsunami basin**
  - **Tank buckling using NEES reaction-wall facility**
  - **Resultant oil spill flow pattern using NEES tsunami basin**
  - **Real-time collaborative simulation and experimentation linking all of above NEES facilities**

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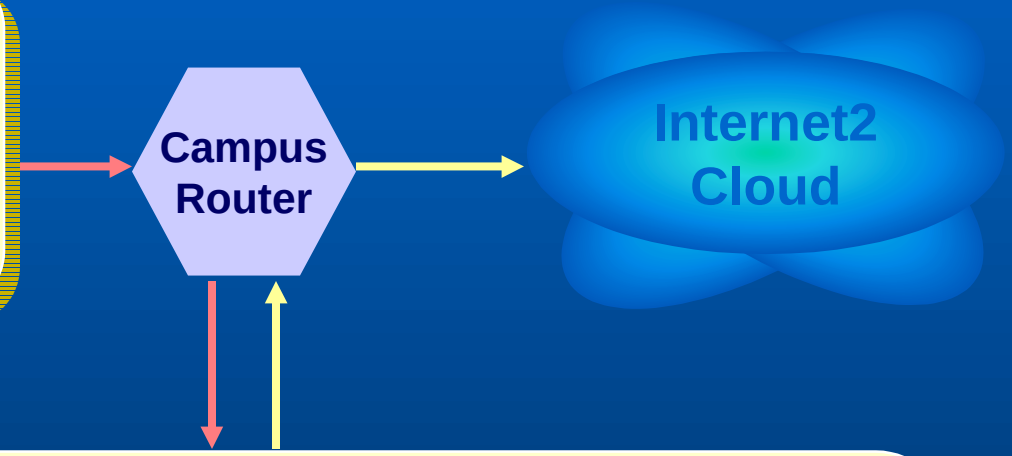
Networking Plan

<u>Wave Research Lab</u>
Data acquisition
Audio/video capture
Temporary caching



<u>NACSE</u>
Data filtering and conversions
Archive: Tsunami Experiment Database
Web-based access to audio/video
Web-based access to Experiment Database
Remote access toolkits

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Key to NEES Program Success

- **Technical Issues**
  - **Experimental facility fulfilling physical requirements of earthquake engineering research community**
  - **Network architecture supporting real-time audio/video communication and data transfer among host and client institutions**
  - **Usability engineering : ease of use by non-experts**
- **Management Issues**
  - **Real-time/off-line host-client efficient interaction protocols**
  - **User fee establishment (community and legal requirements)**
  - **Stable funding support for technical personnel, periodic maintenance and equipment upgrade**
  - **Protocols for timely dissemination of experimental results to PI's, research community and general public**

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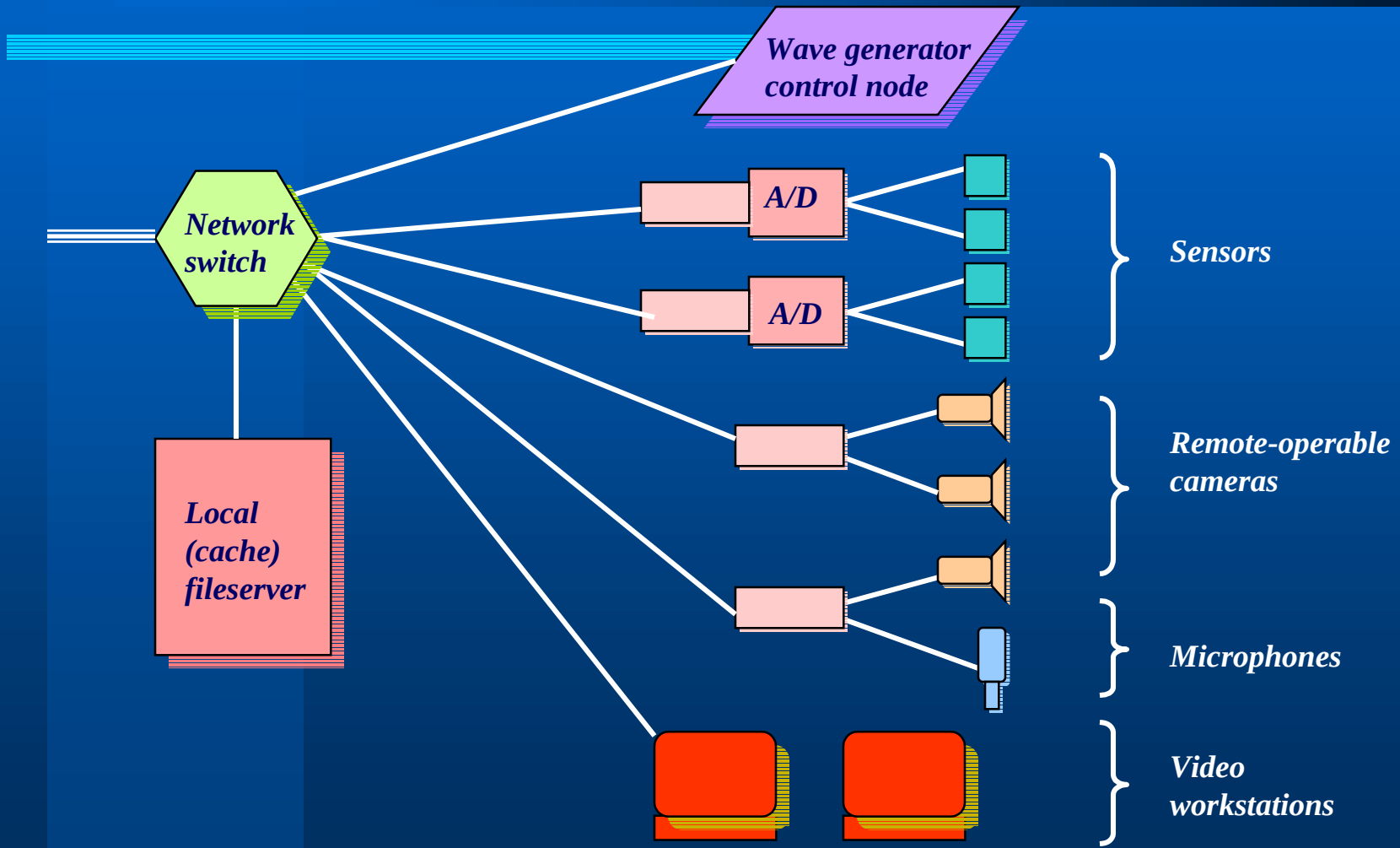
At the WRL



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At NACSE